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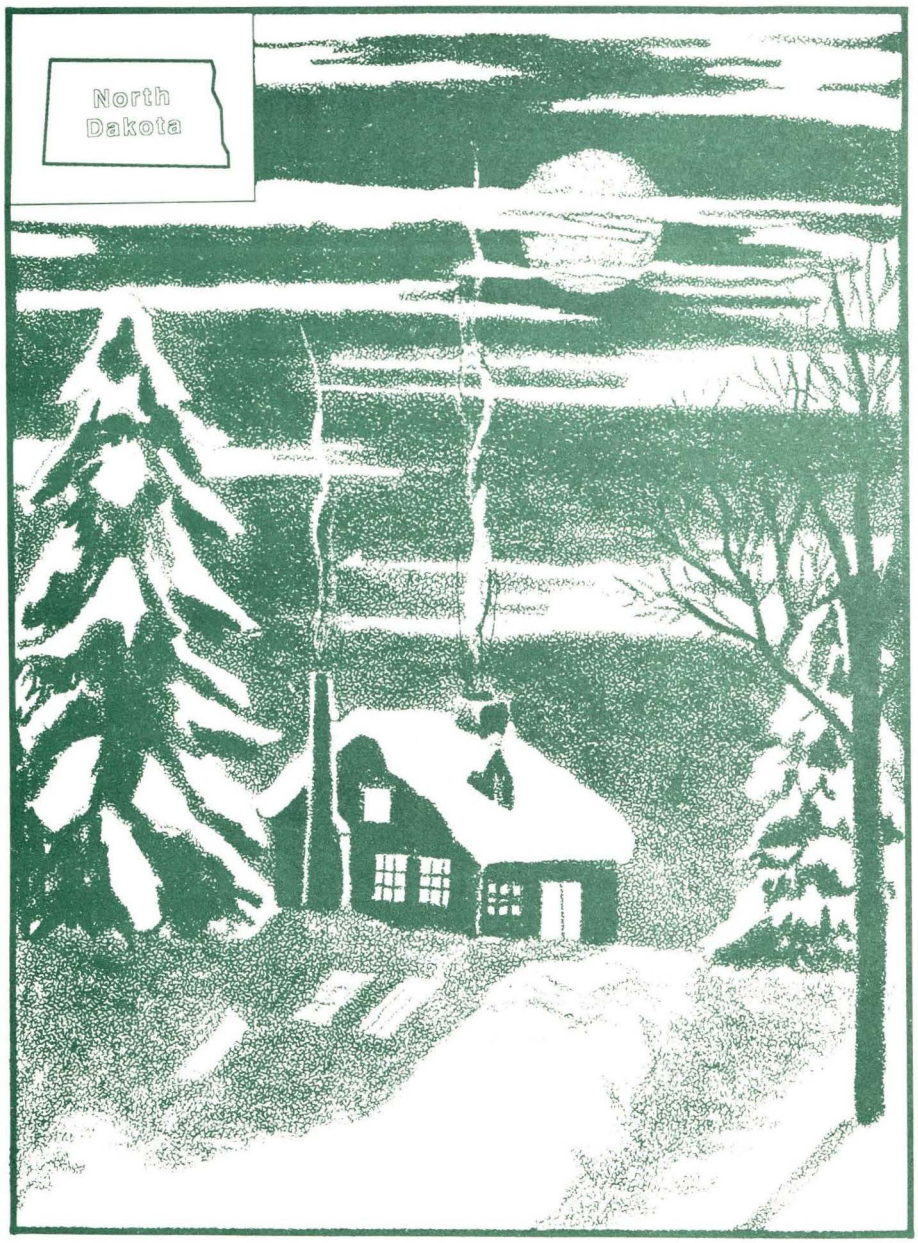
Residential Fuelwood Consumption and Production in North Dakota, 1994

Dennis M. May



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FOREWORD

This bulletin reports the results of a survey of residential fuelwood consumption and production in North Dakota for a 1-year period encompassing the 1993/1994 heating season. Topics examined include the geographic distribution of residential fuelwood consumption and production within the State; the species of trees used for residential fuelwood; the types of wood-burning facilities used; the reasons for burning fuelwood; and the land, ownership, and tree classes from which fuelwood was produced. Such detailed information is necessary for intelligent planning and decisionmaking in wood procurement, forest resource management, forest industry development, and forest research.

Special thanks are given to the North Dakota households and commercial producers who supplied information for this survey. Their cooperation is greatly appreciated.

The Kansas State University Department of Horticulture, Forestry and Recreation Resources is acknowledged for its cooperation in conducting the survey, and special thanks are offered to the faculty, staff, and students involved for their diligence in phoning and questioning the survey respondents.

In this bulletin, consumption refers to the volume of fuelwood burned by North Dakota's households, regardless of the source of the fuelwood (roundwood, wood residues from primary or secondary manufacturing, scrap or waste wood products, etc.). Production refers only to the volume of roundwood harvested to supply North Dakota's wood-burning households. This report *does not* include information about harvesting for industrial fuelwood. Such information is included in reports covering wood use by primary processing plants.

Row and column data of tables may not sum due to rounding, but data in each table cell are accurately displayed.

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Residential Fuelwood Consumption and Production in North Dakota, 1994

Dennis M. May

CONSUMPTION

- About one in four North Dakota households had facilities to burn wood in 1994, but only two-thirds of them actually burned wood in that year (table 1).
- As a result, only about one in six households burned wood in 1994; a similar proportion was expected to burn wood in 1995.
- More than 3,000 households planned to install wood-burning facilities. About two-thirds of these will be new installations; the rest will be replacement or supplemental units for households already engaged in wood burning.
- Most of the increased possession and use of wood-burning facilities is expected to occur in the Western Unit of the State (table 1 and fig. 1).
- On average, each of North Dakota's wood-burning households burned one cord of fuelwood in 1994, for a total consumption of just over 43 thousand cords (table 2).

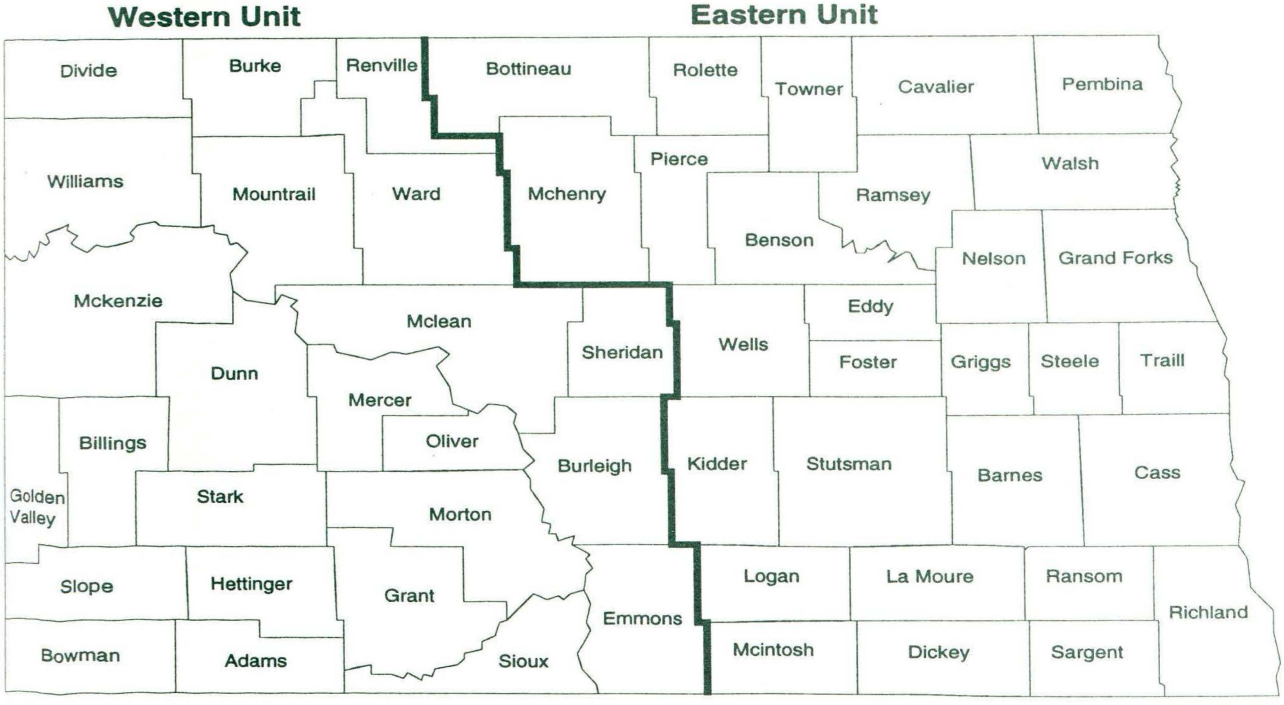

Figure 1.—*Forest Survey Units in North Dakota, 1994.*

Dennis M. May, Research Forester, received a B.S. degree in forest management from the University of Maine and an M.S. degree in forest resources from the University of Idaho. He joined the USDA Forest Service in December 1983, and has been working with the North Central Station's Forest Inventory and Analysis Unit since May 1992.

- Pleasure was the most popular reason for burning fuelwood in 1994.
- On average, households that burned wood for pleasure consumed about half a cord of fuelwood, only a fraction of the volume consumed by households that heated with wood.
- As a result, more fuelwood was consumed for home-heating purposes than for pleasure in 1994 (table 2 and fig. 2).
- Fireplaces were the most popular type of wood-burning facility used by North Dakota households in 1994 (table 3).
- Three-quarters of the households that burned wood in fireplaces did so for recreational purposes, while 82 percent of households that burned wood in wood stoves did so for home-heating purposes (table 4).
- As a result, more fuelwood was burned in wood stoves than in the more numerous fireplaces in 1994 (fig. 3).

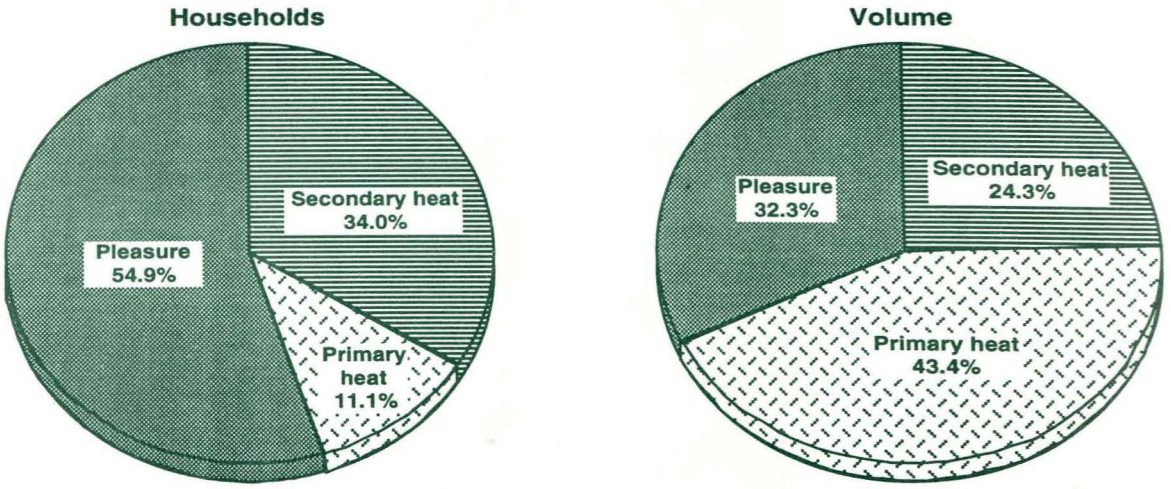

Figure 2.—*Distribution of residential fuelwood consumption by reason for burning, North Dakota, 1994.*

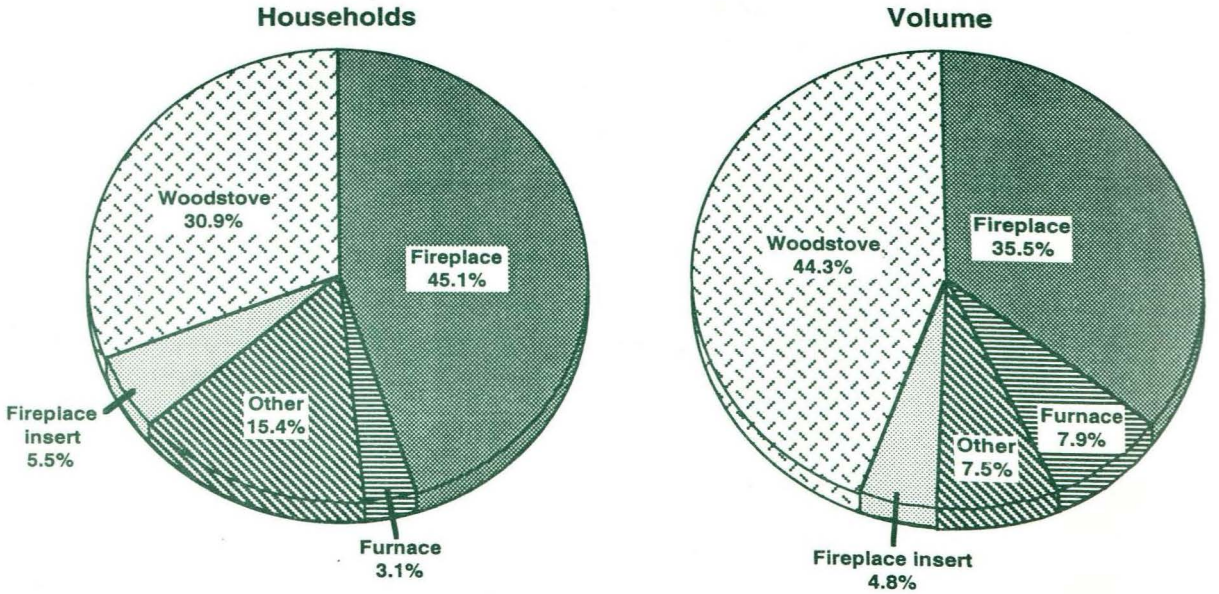

Figure 3.—*Distribution of residential fuelwood consumption by wood-burning facility, North Dakota, 1994.*

- In 1994, the majority of North Dakota's wood burners were long-time veterans who had burned wood for at least 5 years (table 5).
- These veterans were more likely to burn wood for home-heating purposes (fig. 4), and consequently burned three-quarters of all fuelwood consumed in 1994.

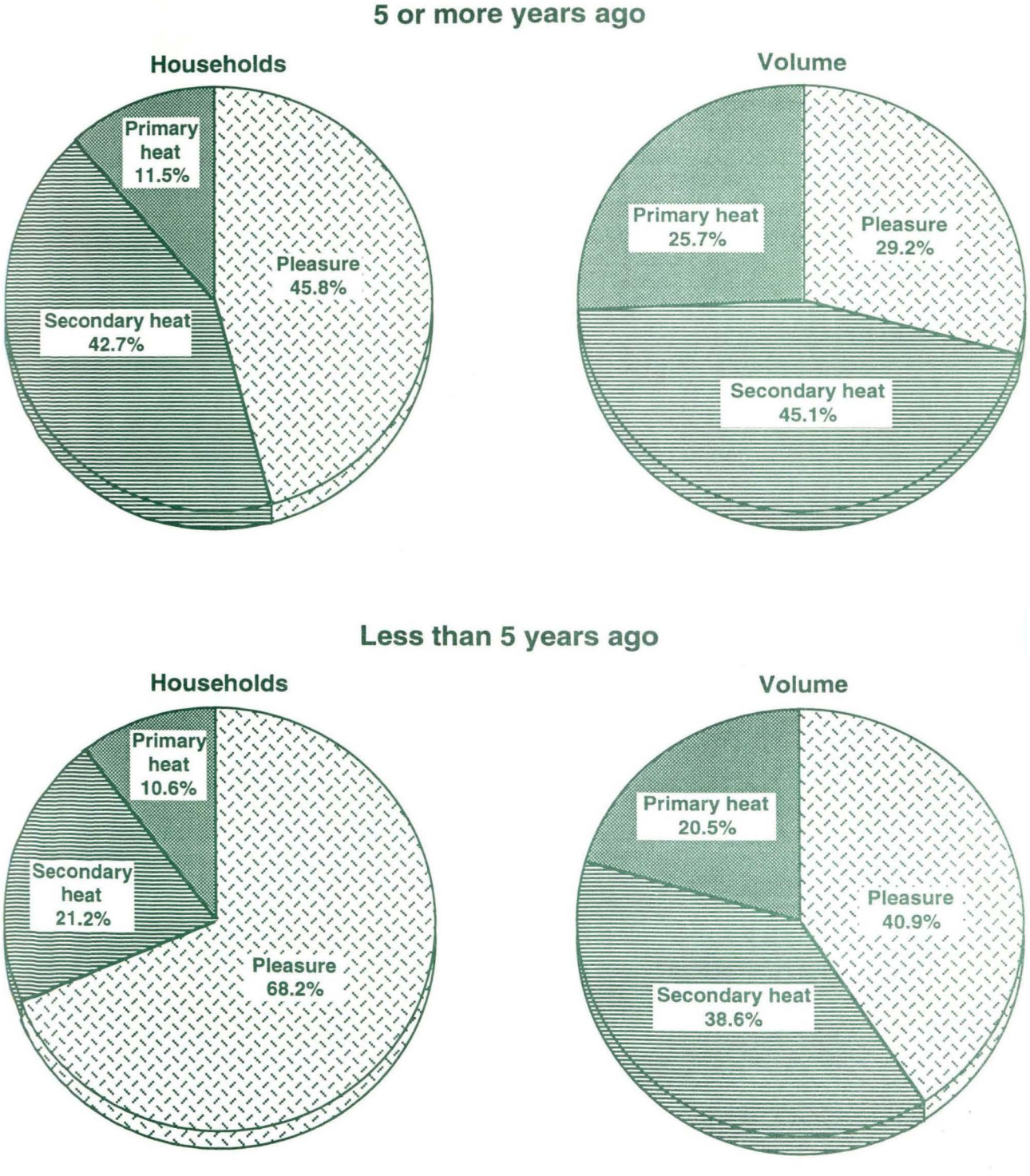

Figure 4.—*Distribution of residential fuelwood consumption by reason for burning and year first burned wood, North Dakota, 1994.*

- More than four-fifths of the fuelwood burned in 1994 was consumed at primary residences (table 6).

- Almost all of the fuelwood burned came from roundwood, but about 12 percent of households relied on wood residues for all or part of their fuelwood needs in 1994 (table 7).

- One species, cottonwood, accounted for more than a quarter of the volume burned. Other major species burned, in descending order of volume, were oak, ash, elm, and birch (table 8).

- More than half (54 percent) of North Dakota's wood-burning households cut all or part of the fuelwood they burned in 1994 (table 9).

- In total, about two-thirds of the volume burned in 1994 was cut by residents of wood-burning households. Most of the remaining volume, 28 percent of the total consumption, was purchased (fig. 5).

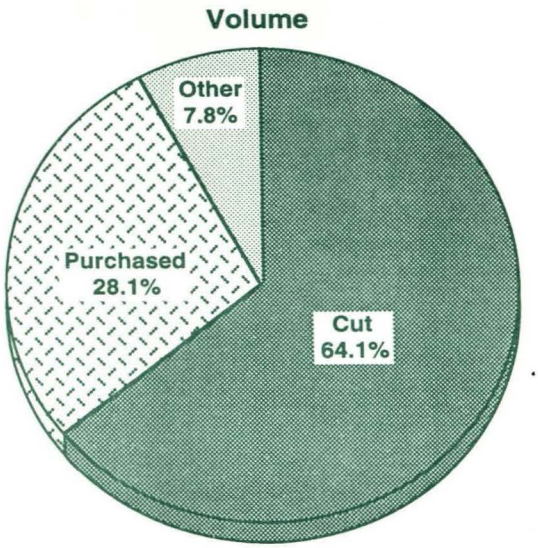

Figure 5.—*Distribution of residential fuelwood consumption by method of procurement, North Dakota, 1994.*

- Purchased wood was most frequently delivered in cords of stove-length wood, commonly referred to as face cords or ricks (table 10). Sixteen-inch wood was most common, but 24-inch wood was also popular.

- On average, households that purchased fuelwood burned about three-quarters of a cord of purchased wood each in 1994.

PRODUCTION

- In 1994, 34 thousand cords of roundwood fuelwood were cut in North Dakota to meet the State's current and future residential fuelwood demands (table 11).

- One-quarter of this volume was produced from forest land sources, mostly dead trees. The remainder was cut from a variety of nonforest land sources, mainly windbreaks, fencerows, and rural yards (fig. 6).

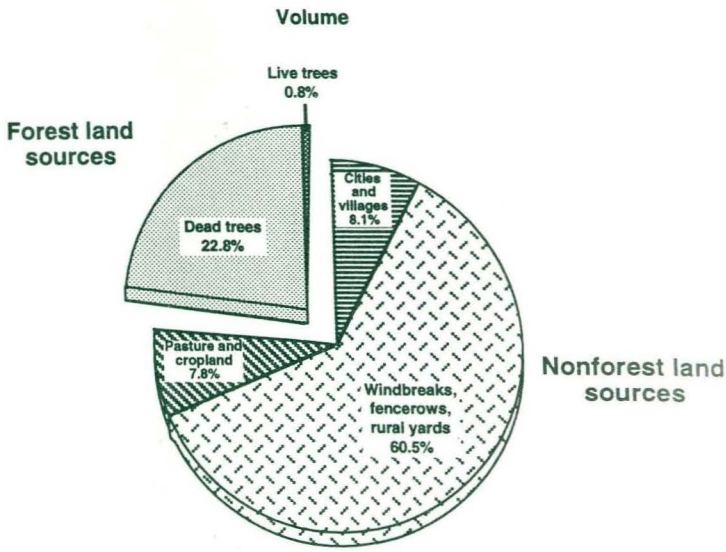

Figure 6.—*Distribution of residential fuelwood production by source of material, North Dakota, 1994.*

- Three species—elm, cottonwood, ash—accounted for three-quarters of the fuelwood cut (tables 12, 13).

- Private lands supplied most (98 percent) of the fuelwood harvested (tables 14, 15).

- In 1994, less than 1 percent of all fuelwood produced was cut from growing-stock portions of live timberland trees (tables 16, 17 and fig. 7). As a consequence, fuelwood removals had negligible impact on the growing-stock inventory of North Dakota, the traditional supply source of the State's primary wood-using industry.

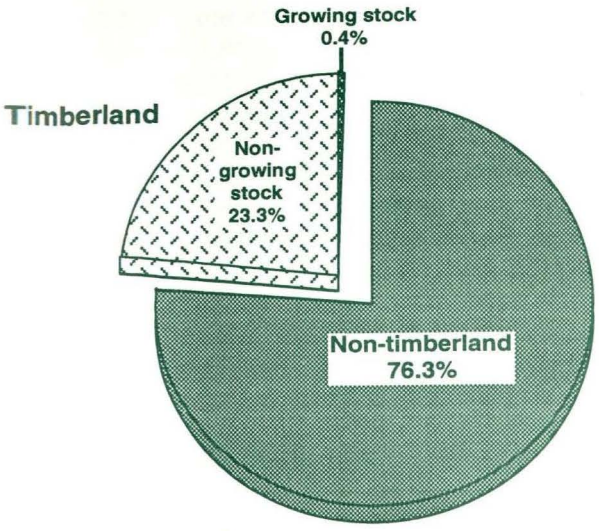

Figure 7.—*Distribution of timber removals associated with residential fuelwood production, North Dakota, 1994.*

APPENDIX

STUDY METHODS

Data for this publication were collected by a telephone survey conducted during September 1994 by the Department of Horticulture, Forestry and Recreation Resources at Kansas State University. The telephone survey sampled North Dakota households and canvassed all known commercial producers, using formal questionnaires prepared by the North Central Forest Experiment Station and approved by the Federal Office of Management and Budget.

Households

The sampled universe encompassed all households in North Dakota with telephones. A total sample size of 900 households was selected based on funding available and a desired standard error of less than ± 20 percent statewide at one standard deviation. The total number of samples was proportionally distributed across the counties in the State based on the number of households in each county. The county samples were evenly distributed across the three-digit telephone exchanges in each county. A random list of telephone numbers was generated for each county using all listed three-digit phone exchanges. One call was placed (whether successful or unsuccessful) to each of the random telephone numbers until the necessary number of residential households within each exchange and county was contacted. In total, about 1 in 267 households were sampled. Sample responses were expanded to population estimates of total fuelwood use based on this sample rate.

Commercial Producers

A list of commercial fuelwood producers was compiled from advertisements for firewood sales discovered in a one time search of all North Dakota newspapers and telephone directory yellow pages. A total of 20 commercial producers were found. All of these commercial producers were canvassed about their production of residential fuelwood, using a formal questionnaire similar to that used for households. Possible duplicate sampling of commercial producers was minimized by cross checking telephone numbers of all sample households producing more than 20 cords of fuelwood against the commercial producers list.

Completed questionnaires were sent to the North Central Forest Experiment Station for editing and processing. Some respondents did not know the tree species cut or burned for fuel, except in general terms such as mixed hardwoods. As part of the processing, general species groupings were prorated to individual species specifically identified as being harvested or burned in a Forest Survey Unit.

Sampling Error

All the reported figures are estimates based on sampling procedures that are designed to give accurate estimates of residential fuelwood consumption and production. A measure of reliability of these figures is given by sampling errors. This sampling error means that the chances are two out of three that the results for the sample differ by no more than the amount indicated from the results that would have been obtained if a complete census of all households and commercial producers had been made. Sampling errors for estimates of residential fuelwood consumption and production in North Dakota are shown below:

Survey	Consumption (Cords)	Error (Percent)	Production (Cords)	Error (Percent)
Residential households	43,218	13.3	34,112	14.9
Commercial producers	—	—	83	—
State total	43,218	13.3	34,195	14.9

STUDY LIMITATIONS

This study reports both the consumption and production of residential fuelwood in North Dakota for a 1-year period ending at the time of the telephone survey, essentially encompassing the 1993/1994 burning season, but dated 1994 for reporting purposes. Consumption refers to the volume of fuelwood burned by North Dakota's wood-burning households, regardless of the source of the fuelwood (roundwood, wood residues from primary or secondary manufacturing, scrap or waste wood products, etc.). Production, on the other hand, refers only to the volume of roundwood harvested to supply North Dakota's wood-burning households. Due to these definition differences, as well as seasoning time, leftover fuelwood inventories from previous years, gift or free wood, cross-State wood movement, fluctuating participation in wood burning, and use of wood residues and wood wastes, estimates of fuelwood production and consumption should not be expected to match in a given year.

Additionally, production does not include fuelwood produced from wood residues generated at primary wood-using mills (such as sawmills and cooperage mills), fuelwood produced from roundwood for industrial consumption, fuelwood produced from wood residues generated at secondary wood-using mills (such as millwork plants and furniture plants), or fuelwood produced from waste wood products. However, fuelwood produced from primary mill residues and fuelwood produced for industrial consumption are captured in other studies. And although fuelwood production from secondary mill residues and waste secondary wood products is beyond the scope of Forest Inventory and Analysis duties, part of this volume is captured in the consumption portion of the residential fuelwood studies.

Households without telephones were not sampled. To compensate for this omission, sample responses from households with phones were assumed representative of the relatively small number of households without phones, and were expanded across all existing households in North Dakota. Study results may be slightly biased if the fuelwood consumption or production per household differs significantly in quantity or sources between phoneless households and households with phones.

Some commercial producers may not advertise in newspapers or the yellow pages, or may not have been advertising when the commercial producers list was compiled. Consequently, some commercial producers may have been excluded from the study, which would result in a conservative estimate of fuelwood production.

To assess the impacts of fuelwood harvests on the State's forest inventory from the telephone survey responses, reported fuelwood harvests from "woodland areas outside of city or village limits" were assumed to be the same as forest land harvests, and all forest land harvests were assumed to be timberland harvests.

DEFINITION OF TERMS

Central stem.—The portion of a tree between a 1-foot stump and the minimum 4.0-inch top diameter outside bark or the point where the central stem breaks into limbs.

Commercial producers.—Commercial fuelwood operators. Those who harvest fuelwood to sell to dealers or consumers. Includes loggers who harvest fuelwood along with saw logs and other products.

Commercial species.—Tree species presently or prospectively suitable for industrial wood

products. (Note: Excludes species of typically small size, poor form, or inferior quality such as hophornbeam, Osage-orange, and redbud.)

Cord (standard fuelwood).—A pile of logs 4x4x8 feet (128 cubic feet including air space and bark). A standard cord of fuelwood contains 70 cubic feet of wood and 58 cubic feet of bark and air space.

Cull removals.—Net volume of rough and rotten trees, plus the net volume in sections of the central stem of growing-stock trees that do not meet regional merchantability standards, harvested for roundwood products.

Dead removals.—Net volume of dead trees harvested for roundwood products.

Diameter at breast height (d.b.h.).—The outside bark diameter at 4.5 feet above the forest floor on the uphill side of the tree. For determining breast height, the forest floor includes the duff layer that may be present, but does not include unincorporated woody debris that may rise above the ground line.

Face cord.—A stack of stove-length wood (most commonly 16 inches wide) that is 4 feet high and 8 feet long, locally referred to as a "rick."

Forest land.—Land at least 16.7 percent stocked by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use. (Note: Stocking is measured by comparing specified standards with basal area and/or number of trees, age or size, and spacing.) The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forest land. Unimproved roads and trails, streams, or other bodies of water or clearings in forest areas shall be classed as forest if less than 120 feet wide.

Fuelwood consumption.—The fuelwood burned by residential households.

Fuelwood production.—The volume of roundwood harvested to supply residential households.

Growing-stock removals.—The growing-stock volume removed from the timberland inventory by harvesting roundwood products. (Note: Includes sawtimber removals, poletimber removals, and logging residues.)

Growing-stock tree.—A live timberland tree of commercial species that meets specified standards of size, quality, and merchantability. (Note: Excludes rough, rotten, and dead trees.)

Growing-stock volume.—Net volume of growing-stock trees 5.0 inches d.b.h. and over, from 1 foot above the ground to a minimum 4.0-inch top diameter outside bark of the central stem or to the point where the central stem breaks into limbs.

Hardwoods.—Dicotyledonous trees, usually broad-leaved and deciduous.

Harvest residues.—The total net volume of unused portions of trees cut or killed by logging. (Note: Includes both logging residues and logging slash.)

Limbwood removals.—Net volume of all portions of a tree other than the central stem, (including forks, large limbs, tops, and stumps) harvested for roundwood products.

Logging residue.—The net volume of unused portions of the merchantable central stem of growing-stock trees cut or killed by logging.

Logging slash.—The net volume of unused portions of the unmerchantable (non-growing-stock) sections of trees cut or killed by logging.

Merchantable sections.—Sections of the central stem of growing-stock trees that meet either pulpwood or saw-log specifications.

Net volume.—Gross volume less deductions for rot, sweep, or other defects affecting use for roundwood products.

Noncommercial species.—Tree species of typically small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial roundwood products.

Nonforest land.—Land that has never supported forests, and land formerly forested where use for timber management is precluded by development for other uses. (Note: Includes areas used for crops, improved

pasture, residential areas, city parks, improved roads of any width and adjoining clearings, powerline clearings of any width, and 1- to 39.9-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, improved roads and nonforest strips must be more than 120 feet wide and more than 1 acre to qualify as nonforest land.)

Nonforest land removals.—Net volume of trees on nonforest lands harvested for roundwood products.

Nontimberland.—The same as nonforest land in this report.

Poletimber.—A growing-stock tree at least 5.0 inches d.b.h. but smaller than sawtimber size (9.0 inches d.b.h for softwoods, 11.0 inches d.b.h. for hardwoods).

Poletimber removals. —Net volume in the merchantable central stem of poletimber trees harvested for roundwood products.

Primary wood-using mills.—Mills receiving roundwood or chips from roundwood for processing into primary products (lumber, plywood, etc.).

Rotten tree.—A tree that does not meet regional merchantability standards because of excessive unsound cull.

Rough tree.—A tree that does not meet regional merchantability standards because of excessive sound cull. Includes noncommercial tree species.

Roundwood.—Logs, bolts, or other round sections cut from trees (including chips from roundwood).

Sapling.—A live tree between 1.0 and 5.0 inches d.b.h.

Sapling removals.—Net volume in saplings harvested for roundwood products.

Saw-log portion.—That portion of the central stem of sawtimber trees between the stump and the saw-log top.

Saw-log top.—The point on the central stem of sawtimber trees above which a saw log cannot be produced. The minimum saw-log top is 7.0 inches d.o.b. for softwoods and 9.0 inches d.o.b. for hardwoods.

Sawtimber removals.—The net volume in the merchantable central stem of sawtimber trees harvested for roundwood products. (Note: Includes the saw-log and upper-stem portions of sawtimber trees.)

Sawtimber tree.—A growing-stock tree containing at least a 12-foot saw log or two noncontiguous saw logs 8 feet or longer, and meeting regional specifications for freedom from defect. Softwoods must be at least 9.0 inches d.b.h. and hardwoods must be at least 11.0 inches d.b.h.

Secondary wood-using mills.—Mills receiving primary wood products for manufacture into secondary wood products (furniture, cabinets, etc.).

Softwoods.—Coniferous trees, usually evergreen, having needles or scale-like leaves.

Tree.—A woody plant usually having one or more perennial stems, a more or less definitely formed crown of foliage, and a height of at least 12 feet at maturity.

Timberland.—Forest land that is producing, or is capable of producing, in excess of 20 cubic feet per acre per year of industrial roundwood products under natural conditions, is not withdrawn from timber utilization by statute or administrative regulation, and is not associated with urban or rural development. In this report, all forest land removals were assumed to be timberland removals.

Upper stem portion.—That portion of the central stem of sawtimber trees between the saw-log top and the minimum top diameter of 4.0 inches outside bark or to the point where the central stem breaks into limbs.

Wood residues.—Includes woody material (bark, coarse, fine, etc.) generated at primary wood-using mills, woody material (sawdust, scrap, trim, wood flour, etc.) generated at secondary wood-using plants, and waste secondary wood products.

COMMON AND SCIENTIFIC NAMES OF TREE SPECIES MENTIONED

SOFTWOODS

Cedar
- Rocky mountain juniper ..... *Juniperus scopulorum*
- Eastern redcedar ..... *Juniperus virginiana*

Pine
- Ponderosa pine ..... *Pinus ponderosa*
- Scotch pine ..... *Pinus sylvestris*

HARDWOODS

Ash
- Black ash ..... *Fraxinus nigra*
- Green ash ..... *Fraxinus pennsylvanica*

Aspen
- Quaking aspen ..... *Populus tremuloides*

Birch
- Paper birch ..... *Betula papyrifera*
- Boxelder ..... *Acer negundo*

Cottonwood
- Eastern cottonwood ..... *Populus deltoides*
- Plains cottonwood ..... *Populus deltoides* var. *occidentalis*

Elm
- American elm ..... *Ulmus americana*
- Siberian elm ..... *Ulmus pumila*
- Slippery elm ..... *Ulmus rubra*

Locust
- Honeylocust ..... *Gleditsia triacanthos*

Oak
- White oak
- Bur oak ..... *Quercus macrocarpa*

Willow ..... *Salix* spp.

Noncommercial species
- Apple ..... *Malus* spp.
- Cherry, plums ..... *Prunus* spp.

TABLE TITLES

Table 1.—Household possession and use of wood-burning facilities by Forest Survey Unit, North Dakota, 1994

Table 2.—Residential fuelwood consumption by reason for burning and Forest Survey Unit, North Dakota, 1994

Table 3.—Residential fuelwood consumption by type of wood-burning facility and Forest Survey Unit, North Dakota, 1994

Table 4.—Residential fuelwood consumption by type of wood-burning facility and reason for burning, North Dakota, 1994

Table 5.—Residential fuelwood consumption by reason for burning and year first burned wood, North Dakota, 1994

Table 6.—Residential fuelwood consumption by place of consumption, North Dakota, 1994

Table 7.—Residential fuelwood consumption by type of fuelwood, North Dakota, 1994

Table 8.—Residential fuelwood consumption by species group and Forest Survey Unit, North Dakota, 1994

Table 9.—Residential fuelwood consumption by method of procurement and Forest Survey Unit, North Dakota, 1994

Table 10.—Residential consumption of purchased fuelwood by size of wood, North Dakota, 1994

Table 11.—Residential fuelwood production by source of material and Forest Survey Unit, North Dakota, 1994

Table 12.—Residential fuelwood production from roundwood by species group and source of material, North Dakota, 1994

Table 13.—Residential fuelwood production from roundwood by species group and Forest Survey Unit, North Dakota, 1994

Table 14.—Residential fuelwood production from roundwood by species group and ownership class, North Dakota, 1994

Table 15.—Residential fuelwood production from roundwood by source of material and ownership class, North Dakota, 1994

Table 16.—Distribution of timber removals associated with residential fuelwood production by Forest Survey Unit, North Dakota, 1994

Table 17.—Distribution of timber removals associated with residential fuelwood production by species group, North Dakota, 1994

Table 1. -- Household possession and use of wood-burning facilities by Forest Survey Unit, North Dakota, 1994

(In number of households)

Forest Survey Unit	Households	Households with wood-burning facilities	Households burning wood in 1994	Households planning to burn wood in 1995	Households planning to install wood-burning facilities
Eastern	142,574	33,685	23,259	22,190	1,069
Western	98,304	30,477	20,051	21,388	2,406
Total	240,878	64,163	43,310	43,577	3,475

Table 2. -- Residential fuelwood consumption by reason for burning and Forest Survey Unit, North Dakota, 1994

Forest Survey Unit and reason for burning	Number of households	Volume (Cords)	Average (Cords/ household)
Eastern			
Pleasure	12,833	9,099	0.71
Primary heat	2,941	7,596	2.58
Secondary heat	7,486	12,242	1.64
Total	23,259	28,937	1.24
Western			
Pleasure	10,961	4,865	0.44
Primary heat	1,871	2,915	1.56
Secondary heat	7,218	6,500	0.90
Total	20,051	14,281	0.71
All Units			
Pleasure	23,794	13,964	0.59
Primary heat	4,812	10,511	2.18
Secondary heat	14,704	18,742	1.27
Total	43,310	43,218	1.00

Table 3. -- Residential fuelwood consumption by type of wood-burning facility and Forest Survey Unit, North Dakota, 1994

Forest Survey Unit and wood-burning facility	Number of households	Volume (Cords)	Average (Cords/ household)
Eastern			
Stove	7,753	13,545	1.75
Furnace	802	2,941	3.67
Fireplace insert	802	1,108	1.38
Fireplace	11,228	9,335	0.83
Fire pit	1,871	1,190	0.64
Combinations	802	818	1.02
Total	23,259	28,937	1.24
Western			
Stove	5,614	5,591	1.00
Furnace	535	492	0.92
Fireplace insert	1,604	966	0.60
Fireplace	8,288	6,008	0.72
Fire pit	3,743	1,135	0.30
Combinations	267	89	0.33
Total	20,051	14,281	0.71
All Units			
Stove	13,367	19,136	1.43
Furnace	1,337	3,433	2.57
Fireplace insert	2,406	2,074	0.86
Fireplace	19,516	15,343	0.79
Fire pit	5,614	2,325	0.41
Combinations	1,069	907	0.85
Total	43,310	43,218	1.00

Table 4. -- Residential fuelwood consumption by type of wood-burning facility and reason for burning, North Dakota, 1994

Type of facility	All reasons		Reason for burning					
			Primary heat		Secondary heat		Pleasure	
	Number of households	Volume (Cords)	Number of households	Volume (Cords)	Number of households	Volume (Cords)	Number of households	Volume (Cords)
Stove	13,367	19,136	3,475	7,448	7,486	10,643	2,406	1,046
Furnace	1,337	3,433	802	1,994	535	1,438	-	-
Fireplace insert	2,406	2,074	-	-	1,337	1,397	1,069	677
Fireplace	19,516	15,343	535	1,069	4,545	4,373	14,437	9,901
Fire pit	5,614	2,325	-	-	-	-	5,614	2,325
Combinations	1,069	907	-	-	802	891	267	16
Total	43,310	43,218	4,812	10,511	14,704	18,742	23,794	13,964

Table 5. -- Residential fuelwood consumption by reason for burning and year first burned wood, North Dakota, 1994

Reason for burning and year first burned wood	Number of households	Volume (Cords)	Average (Cords/ household)
Pleasure			
Last year	8,020	2,835	0.35
2 years ago	2,941	1,486	0.51
3 years ago	802	287	0.36
4 years ago		96	0.36
5 or more years ago	11,763	9,261	0.79
Total	23,794	13,964	0.59
Primary heat			
Last year	1,337	1,529	1.14
2 years ago	267	802	3.00
4 years ago	267	26	0.10
5 or more years ago	2,941	8,154	2.77
Total	4,812	10,511	2.18
Secondary heat			
Last year	1,337	2,346	1.75
2 years ago	802	771	0.96
3 years ago	535	390	0.73
4 years ago	1,069	925	0.86
5 or more years ago	10,961	14,310	1.31
Total	14,704	18,742	1.27
All reasons			
Last year	10,694	6,710	0.63
2 years ago	4,010	3,059	0.76
3 years ago	1,337	677	0.51
4 years ago	1,604	1,048	0.65
5 or more years ago	25,665	31,725	1.24
Total	43,310	43,218	1.00

Table 6. -- Residential fuelwood consumption by place of consumption, North Dakota, 1994

Forest Survey Unit and place of consumption	Number of households	Volume consumed					Average (Cords/ household)
		Primary residence (Cords)	Secondary residence (Cords)	Other building (Cords)	Other[1] (Cords)	Total consumption (Cords)	
Eastern							
Primary residence	18,981	22,601	-	-	-	22,601	1.19
Secondary residence	802	-	3,900	-	-	3,900	4.86
Other building	1,871	-	-	1,722	-	1,722	0.92
Other[1]	1,069	-	-	-	242	242	0.23
Combination	535	245	187	41	-	473	0.88
Total	23,259	22,846	4,087	1,763	242	28,937	1.24
Western							
Primary residence	15,773	13,124	-	-	-	13,124	0.83
Other building	535	-	-	22	-	22	0.04
Other[1]	3,743	-	-	-	1,135	1,135	0.30
Total	20,051	13,124	-	22	1,135	14,281	0.71
All Units							
Primary residence	34,755	35,725	-	-	-	35,725	1.03
Secondary residence	802	-	3,900	-	-	3,900	4.86
Other building	2,406	-	-	1,744	-	1,744	0.72
Other[1]	4,812	-	-	-	1,376	1,376	0.29
Combination	535	245	187	41	-	473	0.88
Total	43,310	35,970	4,087	1,785	1,376	43,218	1.00

[1] Consumed at campsites.

Table 7. -- Residential fuelwood consumption by type of fuelwood, North Dakota, 1994

Forest Survey Unit and type of fuelwood	Number of households	Volume consumed			Average (Cords/ household)
		Roundwood (Cords)	Wood residues (Cords)	Total consumption (Cords)	
Eastern					
Roundwood	20,853	26,387	-	26,387	1.27
Wood residues	535	-	28	28	0.05
Combination	1,871	1,654	868	2,522	1.35
Total	23,259	28,041	897	28,937	1.24
Western					
Roundwood	17,110	12,313	-	12,313	0.72
Wood residues	1,337	-	419	419	0.31
Combination	1,604	991	558	1,549	0.97
Total	20,051	13,304	977	14,281	0.71
All Units					
Roundwood	37,963	38,700	-	38,700	1.02
Wood residues	1,871	-	448	448	0.24
Combination	3,475	2,644	1,426	4,070	1.17
Total	43,310	41,344	1,874	43,218	1.00

Table 8. -- Residential fuelwood consumption by species group and Forest Survey Unit, North Dakota, 1994

(In cords)

Species group	All Units	Forest Survey Unit	
		Eastern	Western
Softwoods			
Cedar	129	-	129
Pine	1,088	546	542
Total softwoods	1,217	546	671
Hardwoods			
Boxelder	2,180	1,327	854
Birch	5,451	3,432	2,019
Ash	7,731	4,246	3,485
Locust	53	53	-
Cottonwood	11,443	7,436	4,007
Aspen	784	309	474
Cherry	53	53	-
Oak	7,827	5,451	2,376
Willow	318	318	-
Elm	6,120	5,725	395
Russian olive	41	41	-
Total hardwoods	42,001	28,391	13,610
All species	43,218	28,937	14,281

Table 9. -- Residential fuelwood consumption by method of procurement and Forest Survey Unit, North Dakota, 1994

Forest Survey Unit and procurement method	Number of households	Volume purchased (Cords)	Volume cut (Cords)	Volume other[1] (Cords)	Total consumption (Cords)	Average (Cords/ household)
Eastern						
Buy[1]	10,426	7,534	-	1,184	8,719	0.84
Cut	10,961	-	17,450	-	17,450	1.59
Cut and Buy[1]	1,871	372	1,724	673	2,769	1.48
Total	23,259	7,907	19,173	1,858	28,937	1.24
Western						
Buy[1]	9,624	4,140	-	1,006	5,146	0.53
Cut	8,288	-	7,442	-	7,442	0.90
Cut and Buy[1]	2,139	119	1,083	491	1,693	0.79
Total	20,051	4,259	8,525	1,497	14,281	0.71
All Units						
Buy[1]	20,051	11,674	-	2,190	13,864	0.69
Cut	19,249	-	24,892	-	24,892	1.29
Cut and Buy[1]	4,010	491	2,807	1,164	4,462	1.11
Total	43,310	12,165	27,698	3,355	43,218	1.00

[1] Includes gift wood, free wood, leftover wood, etc.

Table 10. -- Residential consumption of purchased fuelwood by size of wood, North Dakota, 1994

Size of wood purchased	Number of households	Volume (Cords)	Average (Cords/ household)
16 inch	8,288	7,885	0.95
24 inch	3,743	1,944	0.52
4 foot	1,069	393	0.37
6 foot	267	535	2.00
Random length residues	267	26	0.10
Random length roundwood	2,406	1,383	0.57
Total purchased	16,041	12,165	0.76

Table 11. -- Residential fuelwood production by source of material and Forest Survey Unit, North Dakota, 1994

(In cords)

		Source of material					
					Forest land		
Forest Survey Unit	All sources	Cities and villages	Windbreaks, fencerows, rural yards	Pasture and cropland	Standing live trees	Harvest residues	Dead trees
Eastern	24,665	2,639	15,504	1,756	206	-	4,560
Western	9,530	142	5,159	904	74	-	3,252
Total	34,195	2,781	20,663	2,660	279	-	7,812

Table 12. -- Residential fuelwood production from roundwood by species group and source of material, North Dakota, 1994

(In cords)

Species group	All sources	Source of material					
					Forest land		
		Cities and villages	Windbreaks, fencerows, rural yards	Pasture and cropland	Standing live trees	Harvest residues	Dead trees
Softwoods							
Pine	1,462	-	1,462	-	-	-	-
Total softwoods	1,462	-	1,462	-	-	-	-
Hardwoods							
Boxelder	1,638	69	1,107	462	-	-	-
Birch	706	30	361	315	-	-	-
Ash	5,453	121	3,422	105	-	-	1,805
Locust	40	2	38	*	-	-	-
Cottonwood	9,019	181	6,498	213	111	-	2,015
Aspen	670	28	190	451	-	-	-
Cherry	40	2	38	*	-	-	-
Oak	3,524	76	2,122	690	21	-	615
Willow	242	10	229	3	-	-	-
Elm	11,124	2,258	4,994	347	148	-	3,376
Russian olive	276	3	200	72	-	-	-
Total hardwoods	32,733	2,781	19,201	2,660	279	-	7,812
All species	34,195	2,781	20,663	2,660	279	-	7,812

* Less than one-half cord.

Table 13. -- Residential fuelwood production from roundwood by species group and Forest Survey Unit, North Dakota, 1994

(In cords)

Species group	All Units	Forest Survey Unit	
		Eastern	Western
Softwoods			
Pine	1,462	1,139	323
Total softwoods	1,462	1,139	323
Hardwoods			
Boxelder	1,638	1,638	-
Birch	706	706	-
Ash	5,453	2,865	2,588
Locust	40	40	-
Cottonwood	9,019	6,004	3,015
Aspen	670	670	-
Cherry	40	40	-
Oak	3,524	2,284	1,240
Willow	242	242	-
Elm	11,124	8,956	2,168
Russian olive	276	81	196
Total hardwoods	32,733	23,526	9,207
All species	34,195	24,665	9,530

Table 14. -- Residential fuelwood production from roundwood by species group and ownership class, North Dakota, 1994

(In cords)

Species group	All ownerships	Ownership class			
		Other federal	State	County/ municipal	Other private
Softwoods					
Cedar					
Pine	1,462	-	-	-	1,462
Total softwoods	1,462	-	-	-	1,462
Hardwoods					
Boxelder	1,638	-	-	-	1,638
Birch	706	-	-	-	706
Ash	5,453	73	80	-	5,300
Locust	40	-	-	-	40
Cottonwood	9,019	113	65	6	8,835
Aspen	670	-	-	-	670
Cherry	40	-	-	-	40
Oak	3,524	375	18	-	3,130
Willow	242	-	-	-	242
Elm	11,124	9	29	-	11,086
Russian olive	276	-	69	-	207
Total hardwoods	32,733	569	261	6	31,896
All species	34,195	569	261	6	33,359

Table 15. -- Residential fuelwood production from roundwood by source of material and ownership class, North Dakota, 1994

(In cords)

Ownership class	All sources	Source of material					
		Cities and villages	Windbreaks, fencerows, rural yards	Pasture and cropland	Forest land		
					Standing live trees	Harvest residues	Dead trees
Other federal	569	-	-	369	67	-	134
State	261	-	129	-	-	-	132
County/municipal	6	-	-	-	-	-	6
Other private	33,359	2,781	20,534	2,291	213	-	7,540
Total	34,195	2,781	20,663	2,660	279	-	7,812

Table 16. -- Distribution of timber removals associated with residential fuelwood production by Forest Survey Unit, North Dakota, 1994

(In thousand cubic feet)

Forest Survey Unit	Timberland removals										
	Growing-stock removals			Non-growing-stock removals					Total timberland removals	Non-timberland removals	Total Removals
	Sawtimber	Poletimber	Total	Limbwood	Sapling	Cull trees	Dead trees	Total			
Eastern	4	3	6	2	2	4	319	327	334	1,393	1,727
Western	1	1	2	1	1	1	228	230	233	434	667
Total	5	4	9	3	2	5	547	558	566	1,827	2,394

Table 17. -- Distribution of timber removals associated with residential fuelwood production by species group, North Dakota, 1994

(In thousand cubic feet)

	Timberland removals										
	Growing-stock removals			Non-growing-stock removals					Total timberland	Non-timberland	Total
Species group	Sawtimber	Poletimber	Total	Limbwood	Sapling	Cull trees	Dead trees	Total	removals	removals	Removals
Softwoods											
Pine	-	-	-	-	-	-	-	-	-	102	102
Total softwoods	-	-	-	-	-	-	-	-	-	102	102
Hardwoods											
Boxelder	-	-	-	-	-	-	-	-	-	115	115
Birch	-	-	-	-	-	-	-	-	-	49	49
Ash	-	-	-	-	-	-	126	126	126	255	382
Locust	-	-	-	-	-	-	-	-	-	3	3
Cottonwood	2	2	3	1	1	2	141	145	149	483	631
Aspen	-	-	-	-	-	-	-	-	-	47	47
Cherry	-	-	-	-	-	-	-	-	-	3	3
Oak	*	*	1	*	*	*	43	44	44	202	247
Willow	-	-	-	-	-	-	-	-	-	17	17
Elm	3	2	5	2	1	3	236	242	247	532	779
Russian olive	-	-	-	-	-	-	-	-	-	19	19
Total hardwoods	5	4	9	3	2	5	547	558	566	1,725	2,291
All species	5	4	9	3	2	5	547	558	566	1,827	2,394

* Less than 500 cubic feet.

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Reports findings of the latest survey of residential fuelwood consumption and production in North Dakota. Topics examined include the geographic distribution of residential fuelwood consumption and production within the State; the species of trees used for residential fuelwood; the types of wood-burning facilities used; the reasons for burning fuelwood; and the land, ownership, and tree classes from which fuelwood was produced.

KEY WORDS: Fireplace, firewood, harvest, households, roundwood, wood stove.

Our job at the North Central Forest Experiment Station is discovering and creating new knowledge and technology in the field of natural resources and conveying this information to the people who can use it. As a new generation of forests emerges in our region, managers are confronted with two unique challenges: (1) Dealing with the great diversity in composition, quality, and ownership of the forests, and (2) Reconciling the conflicting demands of the people who use them. Helping the forest manager meet these challenges while protecting the environment is what research at North Central is all about.

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